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Journal of the Society of Arts.

FRIDAY, AUGUST 15, 1856.

ON NEGATIVE ARTESIAN WELLS, OR ABSORBING BORED WELLS, AS A MEANS OF DRAINING LANDS, FARMS, BUILDINGS, &c.[*]

By Augustus Edward Bruckmann, Ph. Dr., Consulting Engineer and Geologist.

(*Concluded from page* 638.)

As soon as I had thus ascertained that the disclosed negative stratum was capable of absorbing far more water than could penetrate into the shaft at any time, even under extraordinary conditions of weather, the chief problem was solved, and I at once proceeded to enlarge the bore, the total depth of which now amounts to 76 feet 8 inches 2 lines from the surface. I fixed its diameter at 5 inches, and after this increase was made I lowered metal tubes, in order to prevent the sides collapsing. These tubes were pierced with small holes, corresponding with the absorbent stratum. In order to tap and drain the ground between the shaft and the retaining wall of the cellar, I carried from out the shaft three holes, in a slightly ascending direction, into the wet marl bed (lying, as has already been stated, at the depth of between 19 and 25 feet) to the retaining wall (see Plates I. and II.) This was successful in completely draining the intermediate ground.

The boring work was thus successfully completed, but before my departure from Stetten, on the 10th of December, 1852, I made arrangements for taking out the timber with which the shaft was lined at *a a a*, and for erecting the necessary masonry, &c., as may be seen on Plate II. Care was also taken to leave means for clearing the hole with a scouring-bit ("Löffel"), if, contrary to all expectation, its stoppage should at any time occur, and for such a purpose the tubes would serve as guides.

In the section Plate II., the general geological groups only are indicated, but not their single strata, because the latter are described below. The subterraneous current and its level are denoted by shading.

The column in the bored hole, continually replenished by the percolating water, does not quite fall to the level of the absorbent stratum, but after several oscillations its level has taken a position of 58 feet 5 inches below the surface of the soil. In the disclosed negative stratum, a current of water moves from south-east to north-west, and, if we compare the latter to a communicating tube, this perforation represents a natural piezometer,[*] which would even have served *for a positive artesian well under other local circumstances, that is to say, in a lower situation of the soil.* The water of this absorbent stratum must be in communication with the outbreaks of springs in the deeper lying valley of the Lone, or, extending our notions, with the powerful Buch spring, rising at the bottom of the mountain castle of Burgberg, three and a-half English miles from Stetten, where that spring breaks forth with great force in the bottom of a valley out of a rock of coral rag, similar to the sources near Aach, Urspring, Honau, Blaubeuren, Königsbronn, Aalen, and Gössweinstein, already mentioned.

The geological and hydrographical section of the above-mentioned bore shows, in descending succession, the following strata:—

	Wirtemberg.[*] Ft.	In.	Lines.
Alluvium.			
Rubbish (of buildings)........................	2	5	0
Miocene Marine Molasse.			
Rusty brown clay, towards its lower part passing into greenish brown loose sandstone (molasse); a thin layer of the molasse of Niederstotzingen	10	5	0
Freshwater bed of the Molasse.			
Compact crumbling yellowish gray calcareous marl, with rusty yellow streaks, enclosed pebbles of jura limestone (coral rag), and a few fragments of land and freshwater shells	16	0	0
Closely pressed masses of compact whitish marl, the intervals filled with greyish white tenacious clay; passing into compact clay marl, with nodules of hornstone	25	0	0

N.B.—Out of this mass, from the depth of 19 feet, the percolating water entered the shaft from the east, while the bed below the depth of 25 feet was dry.

	Ft.	In.	Lines.
Compact blueish grey clay marl, spotted with rusty brown and rusty yellow,[†] with numerous pebbles of jura limestone of different sizes, nodules of horn-stone, and some silicified zoophytes of the genus "Scyphia;" they occur here, though originally belonging to the upper jura formation. No water in this deposit. The pieces of limestone and the boulders became larger as the depth increased ...	32	9	2
Somewhat loose blueish grey and yellow spotted (dry) clay marl, with pebbles of jura limestone, and horn-stone of the size of an egg, sometimes of a fist, crowded together as a conglomerate.................	37	9	2
Porous rusty yellow and reddish speckled stony marl..	38	4	3
Porous yellowish and reddish speckled stony marl, with a few small pebbles of jura limestone, passing into reddish yellow clay marl, with blueish grey spots, and containing some small pebbles of coral rag. Very tenacious, and not in the least sandy	48	9	9
Compact whitish argillaceous limestone (freshwater limestone), without pebbles	50	7	9
Reddish yellow, blueish grey spotted tenacious clay marl, with small pebbles of limestone	53	7	9
Compact whitish argillaceous limestone ...	55	2	7
Tenacious yellowish clay marl	55	5	7
Compact argillaceous limestone, with a hard basis	57	8	0
Blueish yellowish spotted and somewhat sandy clay marl, with small pebbles of limestone	58	8	0
Hard stony marl (freshwater limestone) ...	59	0	9

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[*] Compare my German edition of "Viollet's Théorie des Puits Artésiens," with appendices by me; or see the original work, "Théorie des Puits Artésiens, suivie d'une instruction pratique très-étendue sur les moyens d'utiliser ces puits dans les arts et dans l'agriculture; par J. B. Viollet, ingénieur civil hydraulicien, spécialement pour les opérations d'art et les mémoires contentieux relatifs aux litiges qui s'élèvent sur l'usage industriel des cours d'eau; membre de la Société d'encouragement pour l'industrie nationale, &c., &c., Paris. 1840." According to a communication made to me by Mr. Viollet in a letter, a second edition of this work has now been published

[*] 100 Wirtemberg feet correspond to 94·573 English feet.

[†] Corresponding with several marls of the freshwater formation, which I perforated in the year 1835, while establishing three (positive) artesian wells for Francis Count of Castel-Dischingen, &c. See my work, "Die denkwürdigen artesischen Brunnen zu Ober Dischingen in Württemberg, in geognostish-hydrographischer und constructiver Beziehung. Mit einer Steintafel. Heilbronn am Neckar, J. D. Classische Buckhandlung, 1836."

	Ft.	In.	Lines.
Tenacious yellowish clay marl, passing into compact stony marl, with pebbles of jura limestone, several of which, at a depth of 62 feet 7 inches, fell in during the boring, and set fast the borer, but it was always readily loosened again in a few minutes. Some pebbles of the size of eggs were brought up...............	63	2	1
Compact tenacious clay marl, yellowish colour prevailing, but a few blueish spots	66	3	3
Hard marl slate (slaty freshwater limestone)	66	7	3
Absorbent stratum, or subterraneous current of water, which the borer rapidly cut through; filled with sand and pebbles of jura limestone; also some pieces of clay marl which had fallen in. The water, accumulated in the shaft, began to sink, and had soon disappeared. In the course of clearing this stratum many pebbles, together with sand, were brought up with the scouring-bit ("Löffel")......	69	7	2

JURA FORMATION.—A.—PORTLAND DEPOSITS.

	Ft.	In.	Lines.
Hard whitish stony marl	70	1	3
Tenacious greyish white clay marl	72	5	5
Compact whitish stony marl....................	73	7	5
Tenacious greyish white clay marl	74	8	2
Very compact whitish stony marl, passing into very tenacious greyish white clay marl, with small pebbles of jura limestone	76	1	8

B.—CORAL RAG.

	Ft.	In.	Lines.
Very hard coral rag; basis of the series ...	76	8	2

The thickness of the single strata can easily be found by simple subtraction.

The mass of marl brought up in sinking the shaft was thrown together in a heap, for the convenience of applying it, when required, to the manuring of marshy meadows.

ABSORBING BORED WELL IN THE OLD ALE-CELLAR.

I have already observed that this boring was executed during the sinking of the shaft at the new cellar. It was necessary to hasten it, because the old cellar has always to be first filled with beer, and the chief matter in question proposed to me was, first of all to try, by an experimental perforation in the cellar itself, whether, through the latter, it might be possible or not to carry off the water which entered along its eastern abutment, "Widerlagermauer." Up to this time, namely, in the old cellar, there was a reservoir lined with masonry, placed at *a* (see Plate I.), into which the water entering the cellar flowed, by means of gutters in the floor. At that spot, whenever the reservoir was full of water, it was drawn into casks, which had to be rolled from *a* to *c*, in order to be raised, by a crane placed above, through the opening at *c*, which served for letting down and raising the beer barrels. If this tedious and troublesome operation was not regularly performed in good time, the reservoir overflowed, and by degrees the whole bottom of the cellar was covered with stagnant water,* emitting a nauseous smell. The same thing happened sometimes in the new cellar, whenever they had neglected to pump the water out of its reservoir at *b*.

I now come to the boring immediately in the old cellar itself, though I did not quite agree with this proceeding, for I should have preferred, as a more rational mode, first to wait for the result at the new cellar, and then, in any event, to intercept the water on the outside, and carry it down as I had done in front of the new cellar. By this means I should have preserved its masonry, and drained it perfectly. However, circumstances rendered it desirable, in some respects, to adopt this plan, and I was urgently requested to undertake it. The success may be called a fortunate one, the more so as a further improvement of it may, without doubt, be made at any future time.

We proceed to an account of this boring and its result.

First of all I directed a pit to be cut out, 3 feet 8 inches deep, and 4 feet square, perpendicularly, under the centre of the opening at *c*, and in the porch of the cellar, into which a wooden tube was inserted perpendicularly, and fastened in it. This spot was the most fitted for the perforation, for the aforesaid opening, 22 feet 4 inches 3 lines deep, over which a verandah is built, afforded sufficient space to let down and pull up the borer, together with the boring rods (iron bars); and the crane already placed above, and serving to raise and lower beer barrels, could conveniently be used for my purposes.

The newly-made sink-hole at *c* stands in a greyish white and compact argillaceous limestone, occasionally penetrated by small veins of greenish grey clay; it is a real freshwater limestone, but I could not discover any fossils in it, while the latter frequently occur in the freshwater limestone of the environs, even near the neighbouring town of Niederstotzingen, belonging to the genera *Helix*, *Planorbis*, *Cyclostoma*, *Limnaea*, &c. The freshwater limestone, together with its marls (it is itself for the greatest part nothing but a stony marl), constitutes the outermost southern hills and mountains of the Alps near Ulm, and the adjacent plateaus of the mountains at that place.

While the bottom of the new cellar, at its eastern retaining-wall, is situated 27 feet 3 inches under the surface, that of the old cellar, at the opening, *c*, lies only 22 feet 4 inches 3 lines under the soil, and the horizontal distance from the perforation at the former to that of the latter amounts to 133 feet, in a south-western direction, as may be gathered from Plate I.

On the 12th of October, 1852, the boring in the old cellar was begun—in the fresh-water formation. I must premise, that much less water (likewise coming from the east-side of the fir-wood) entered this cellar than the new one, before it had been provided with its negative artesian well, and the water in the former increased noticeably only in the time of heavy showers of rain. According to my own observations, the most rain-water always came in at the spot *d*, (see Plate I.) and ran off together with the drainage water to the pit *a*, which, after all, was not conveniently placed. After the boring in this cellar was finished, of course it was done away with entirely.

When, between the depth of 28 feet 7 inches 3 lines and 38 feet 4 inches 3 lines (measuring from the surface of the soil), compact white stony marls had been cut through, in which a cavity of one inch in depth occurred, as may be seen in the description of the geological section further back, water *poured* into the bored hole began gradually to sink down. The new sink-hole was now quite filled with water, and I perceived that even this water had entirely disappeared after six days. This slow absorption was, of course, not sufficient for the intended purpose, and, continuing the perforation, after a stratum of very hard freshwater-limestone was cut through, a sandy marl, 2 feet 5 inches 2 lines thick, was disclosed at a depth of 43 feet 1 line, in which the chief absorption of the water takes place, although the boring was carried down to a total depth of 52 feet 8 inches 6 lines.

I made several experiments with reference to the water *poured* in, but I must confine myself to giving here only the most important results.

On the 28th of October, in the afternoon, at half-past one o'clock, so much water was poured into the bored hole, that the level of the column stood 27 feet 2 inches 3 lines below the surface of the earth; in the evening, at eight o'clock, it had sunk down to 35 feet 2 inches 3 lines, and on the 29th of October, at six o'clock in the morning, the level stood 37 feet 1 inch 3 lines below the surface. We see that, according to hydrostatic laws, the sinking of the water took place with decreasing velocity, as was the case in the first perforation already described.

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* As the brewer's men told me there, "The water grew mouldy or covered with a thin white film."

The level of the water *poured* into the bored hole on the 29th of October at six o'clock in the evening, settled at 36 feet 5 inches 8 lines below the surface, but during the night it fell down 3 feet 4 inches, thus, the diameter of the perforation having 4-tenths of a foot,* 427 cubic inches and 40 cubic lines of water sank, whilst in the very same space of time, in the old pit at *a*, only 194 cubic inches and 481 cubic lines of water accumulated; therefore, in that night, 232 cubic inches and 559 cubic lines of water more escaped in the bore than rose in the old reservoir. This reckoning, however, affords only an approximate result, for the quantity of water absorbed in the perforation must have been more considerable, because at the same time the new sink-hole at *c* took up the drainage-water coming in at *d*, and let it into the hole.

After such pleasing results, although they cannot be compared with those obtained at the new cellar, on the 2nd of November, I had *all* the drainage-water accumulating in the cellar conducted provisionally into the new sink-hole, and consequently into the bore itself. In doing so, the arrangement was made so that not a drop more water could pass into the old reservoir at *a*, moreover, the new sink-hole, and along with it the perforation, was filled with water again, and in an hour's time 947 cubic inches and 100 cubic lines of the water thus collected went off from the pit. The column of water sank by degrees from 40 to 43 feet deep below the surface of the soil, and slowly oscillated up and down in this position.

These proofs, witnessed partly by the Count of Maldeghem, partly by his steward, Mr. Keller, admitted of the supposition that the absorption in the bored hole, though slow, was yet sufficient, even if the quantity of the percolating water in the cellar should, by any chance, be doubled or trebled. On the 6th of November the boring-works were ended, and the perforation at the new cellar, already described, was undertaken after the shaft had been sunk; at the same time the bottom of the old cellar was relaid, so that all the entering water flows through channels with a gentle descent directly into the new sink-hole at *c*, that is, into the bore. By this means the old reservoir at *a*, besides being very ill situated, was entirely superfluous, and was therefore filled up and covered with squares of stone, like the bottom of the cellar.

The strata of ground cut through in the old cellar proved sufficiently compact to render it unnecessary previously to sink a protecting-tube into the bored hole; but in order, as far as possible, to prevent the stoppage of the latter with mud from the dirty water, I directed a tube of sheet-copper to be made, 3 feet long, and pierced with fine holes, having on the top a handle and neck, and at the bottom a valve, like a scouring-bit. This hollow copper-cylinder was suspended in the bore-hole at the bottom of the new sink-hole after the wooden tube had been taken out. It is intended to collect the particles of mud from the water flowing in. From time to time it may be taken out and cleaned, which can be easily and quickly performed by means of the valve.

It may indeed happen, in the course of time, that by gradual and permanent softening of the penetrated marls, a stoppage of mud may take place in the bore, which would involve the necessity of opening the latter, with a scouring-bit, and of protecting it with metal-tubes, as in the first perforation at the new cellar. As I have already distinctly remarked, this work, in a technical point of view, can be considered only as provisional and experimental, though at present answering its purpose.

As long as I was in Stetten, that is, to the 10th of December, 1852, it never happened that the new sink-hole was quite filled with drainage-water, so as to render it necessary to bring it up in casks; even this, in the present position of the new sink-hole (at *c*), could be managed much more easily and quickly than formerly. The perforation has always received and carried off the drainage-water which entered. I perceived that in consequence of the heavy and almost continued falls of rain in the month of November, which gave rise to a considerable increase of water draining into the cellar, the column of water in the bored hole gradually rose higher and higher, and in the beginning of December, 1852, even in the new sink-hole itself, some water had accumulated. However, it seems never to have reached the upper edge of this pit, but to have sunk again by degrees, no doubt through the diminution of the rain. In general, the perforation seems to possess a sufficient capacity of absorption even in extremes of rainy weather; for as I inquired after the fate of my works from the Count's steward, Mr. Keller, more than a year afterwards (January 28, 1853), he sent me on the 3rd of February of the same year, the following agreeable communication:—

"*I am very much pleased with the state of your borings. The sink-hole in the old cellar always carries off the water satisfactorily, and the perforation at the new cellar is permanently absorbent, in such a degree, that in the interior of the cellar up to this time no percolation of water could be perceived.*"

As before stated, the perforation in the old cellar lies to the south-west, at a distance of 133 feet from that of the new cellar, and consequently the former somewhat nearer to the upper belt of the "Gemeinde" than the latter; with this trifling difference of distance one would have expected a tolerable similarity in the geological strata sunk through at both places, but it was not so, although the general character of the ground, fresh-water formation subjacent to marine miocene molasse, was the prevailing one; and here I must observe that the upper floor of both cellars (very little elevated above the surface of the earth) is situated at the same level.

The strata cut through in the old strong-ale-cellar are as follows:—

	Ft.	In.	Lines.
During the time of digging out the cellar they found, as I was told, clay marl with imbedded pieces of limestone, to a depth below the surface of..................	18	0	0
Here began the grayish white and compact argillaceous limestone (fresh-water limestone) free from fossils, penetrated by some veins of greenish gray clay, as has been already mentioned; the bottom of the cellar consists of this limestone, and the new sink-hole was cut out of it. ...	28	7	3
Compact whitish stony marl, with hard pieces of limestone imbedded.	35	7	3
A cavity, 1 inch deep occurred, in which the borer sank rapidly; *first, but slow absorption of water*............................	35	8	3
Compact whitish stony marl.	38	4	3
Extremely hard fresh-water limestone passing into reddish colour, upon which the borer violently rebounded, and penetrated as slowly as in the hardest coral rag; no fracture of the borer, however, occurred.	43	0	1
Compact whitish marl, passing into bluish and yellowish spotted somewhat sandy clay marl, with enclosed small pieces of jura-limestone; *second, and principal absorption of water in this stratum*.............	45	5	3
Tenacious bluish and yellow speckled clay, with small pieces of jura-limestone. ...	46	5	3
Hard stony marl (fresh-water limestone) ...	47	4	3
Yellowish gray compact clay marl........	49	5	6

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* In Wirtemburg the decimal measure is employed, a foot being divided into *ten* inches.

	Ft.	In.	Lines.
Extremely hard fresh-water limestone, as above, between the depth of 38 feet 5 inches 3 lines and 43 feet 1 line; end of the series	52	8	4

I must also draw attention to the circumstance that, during the establishment of both these borings, no communication could be discovered between the water in the shaft at the new cellar and the column of water of the perforation in the old ale-cellar, although it was to be expected, considering the trifling distance of these two points, and the constant endeavour of water to find its level. Thus, for example, on the 23rd of October, at six o'clock in the morning, the level of the water of the bore in the old cellar stood at 37 feet 1 inch 8 lines below the surface, whilst, at the same time, the level of water in the shaft at the new cellar was at 28 feet 6 inches below the soil, showing a difference of 8 feet 5 inches 8 lines, a phenomenon which is due to the dissimilarity of the beds of the two localities. Further, I must add that the absorbent strata at both points do not exert the slightest influence on the neighbouring springs and flowing wells of Stetten, as I had expected and had predicted immediately after the termination of my geological and hydrographical examination of that place.

The chief conditions of the successful negative artesian wells at Stetten have been now described; the future will confirm their advantage and benefit, and at once prove that under the prevailing circumstances and geological and hydrographical conditions of that place, now clearly made known by both the undertakings, any other mode of operation (*e. g.*, the driving of a tunnel or a gallery) would have been less successful, and in any case would have been far more expensive than my rapidly completed borings, during which no accident occurred. Both these undertakings, including all preparatory works and the construction of the shaft, took up only from the 27th of September to the 10th of December, 1852, and cost altogether about £200.

It is also obvious that the same complete success might with certainty have been obtained in the front of the old cellar as in the case of the new one, and that even the latter could, in a certain degree, be brought to a greater perfection. In my original German edition I made some remarks on this point, pp. 56—59, but I omit them here, as they are purely technical, in order not to become tedious to the reader. With respect to the new cellar, however, I cannot forbear observing, that according to a communication from the Count's steward, Mr. Keller, of the 12th of September, 1854, one of my proposed measures has since been put into practice, that is, along the southern and northern abutments of the cellar, on its floor and adjacent to the walls, small channels have lately been placed for a short distance, with a gentle fall to and round the retaining wall at *h* (see Plate I.). Through the latter a small drain, in combination with these channels, has been established, reaching into the shaft, so that, if heavy and unusually long rains should occur, or a deep snow should melt rapidly, and unexpectedly send some water into the cellar, the latter must flow off quickly to the shaft and sink in the perforation along with the continuously percolating water. Together with this communication I received a testimonial from the Count of Maldeghem.*

I have yet one other remark to make:—

In certain cases, and especially if the percolating water be of a good quality and occur in a large quantity, pump-wells can be established, together with negative artesian wells, in the following manner:—

When the shaft has been sunk, a water-proof tube should be forced down through the bottom for a certain distance into the ground (entirely depending upon the nature of the latter). If the bottom of the shaft should consist of rock, the tube must be inserted into it another way, but in any case it should be water-tight. Through the interior of this tube of course the boring must be made; now, if the water in the shaft has risen to a certain height, and the absorbent bore is finished, this tube must be provided with holes at the proper spot,* and through these holes the superfluous percolating water must flow into the absorbent bored hole, but the small holes pierced through the tube must always lie a little deeper than the bottom of the cellar, &c., to be drained. The water remaining behind in the shaft being continually renewed (the quantity depending on the depth of the shaft, and the more or less efficient percolation), could always be raised as wanted, by means of a pump to be placed down the side of the shaft. Such a combination may afford great advantages under certain circumstances and in certain localities, for agricultural, manufacturing, or domestic purposes.

Final Remarks.

Although the negative artesian wells at Stetten show, on a comparatively small scale, only an example of what may be performed in more important and extensive cases, yet they show us the indisputable fact that such borings may be undertaken with much confidence of success, provided that the respective localities unite those necessary qualifications which must be always ascertained by a previous careful geological and hydrographical survey of the place, like that which I made in Stetten, before I undertook my perforations, and after I had pointed out the impossibility of establishing a positive artesian well in the garden of the castle at Niederstotzingen, for reasons which I have already given.

My own experience during many years has taught me, and the same inference may be drawn, no doubt, from the experience of England, that many more localities are fitted for establishing negative artesian wells than positive ones. If we are mindful of the great advantages the former afford for the purposes of agriculture, commerce, the purifying of the atmosphere, the draining of houses, &c., and, in proper positions, even of whole towns,† then it may be expected that public attention will be more surely directed to a plan involving such important consequences, and which, in suitable localities, can be carried out more simply and cheaply than the ordinary methods of drainage.

As it is well known that positive artesian wells can successfully be established in different parts of England, there can be no doubt that the important characteristics for the certain success of absorbing bored wells exist in many places, and on a more extended scale, than has hitherto, to my knowledge, been attempted. The British islands seem, for the purposes in question, to be more favoured by nature than any other country of Europe, for they are on every side surrounded by the sea, into which thousands and thousands of subterraneous currents must flow; and, moreover, they contain many very interesting changes of geological formations, positions, and disturbances, with elevations. Considering all these favourable particulars, I can only wish that I could be permitted to take in hand geological and hydrographical examinations, as well as actual works, in order to make use of that experience in my favourite pursuit, gathered in different countries and formations of Germany and France during some twenty years, and to show, by establishing negative artesian wells in England, what may frequently be done in a simple way, for draining purposes, if we properly make use of the advantages offered by nature.

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* *Testimonial*:—"In consequence of the percolation of water into my strong-ale-cellar at Stetten, not only were the flavour and quality of the ale frequently injured, but also the barrels to a very great extent. I, therefore, requested the engineer and geologist, Dr. Bruckmann, of Stuttgart, to remove this evil. On the 27th of September, 1852, he began to establish an absorbing bored well, the construction of which he finished on the 8th of December, 1852, with care, unwearied activity, and prudent economy. This performance of his was crowned with the happiest success, for, since that time, the percolating water is absorbed by the shaft sunk by him, and the cellar is quite dry. Not only in this, but also in other hydraulic works, Dr. Bruckmann rendered essential services to me, and therefore it affords me real pleasure to give him the present testimonial.—Nieder-Stotzingen, in the Kingdom of Wirtemberg, and the bailiwick of Ulm, the 12th of September, 1854.

(L.S.) "COUNT OF MALDEGHEM."

* It is very desirable to pierce the tube in question *after* the disclosure of the absorbent stratum or cleft, and never before or during its progress, for it may be necessary in the course of the boring to lower and prolong it further.

† It is a matter of course that my considerations relate only to fluids; as for solid substances, I refer, for the present, to M. A. Chevalier's account, quoted in the first division of this paper.

I have been astonished to learn, since my arrival in England, what an amount of activity, skill, and means, have been already expended for draining purposes, to which I found references in Mr. Dempsey's very interesting "Rudimentary Treatises on the Drainage of Districts of Lands," and on the "Drainage and Sewage of Towns and Buildings." London: Weale, 1854.* In the *Manchester Examiner and Times* of Jan. 5, 1856, I find the following article:—

> "AGRICULTURAL DRAINAGE IN ENGLAND.
>
> **"To understand clearly the advance made in underdraining and the extent of work yet to be done, the whole country was divided, geologically,† into three great characteristic areas. First, the western and north-western or alpine district of primary and transition rocks. In this, the quantity of land permanently drained does not exceed 500,000 acres; so that 7,525,000 acres of wet land yet remain to be done, at an outlay of £35,000,000. Second, the middle district, including all the secondary strata, exclusive of and up to the lower margin of the chalk. In this, the quantity of land permanently drained may be about 415,000 acres, so that there still remains to be done about 10,000,000 acres, at an expense of £50,000,000. Third, the eastern and south-eastern districts, comprising the chalk of the upper secondary strata, the wealden, and the tertiary and the post-tertiary deposits overlying the chalk. In this, it may be assumed that 450,000 acres have been permanently drained, including the metropolis, leaving 4,000,000 acres still requiring draining, at a cost of at least £22,000,000. These sums, though apparently large, cannot be so regarded when compared with those expended on other national enterprises. By their means there would result an increase of food in the aggregate of at least 5,330,000 quarters of the several kinds of corn which constitute the country's produce. Many practical men spoke of the increase on drained land as one-fourth, but none laid it at less than four bushels per acre."**

The *Journal of the Society of Arts, and of the Institutions in Union*, London, Vol. IV., No. 160, December 14 1855, contains a very valuable treatise "On the Progress and Results of the Under-Drainage of Land in Great Britain,"* by J. Bailey Denton; and the above paragraph, on "Agricultural Drainage in England," is, I am satisfied, a short abstract from it. To Mr. J. B. Denton's treatise an enumeration of the present literature on drainage is added, on pp. 54-56; and the discussion on his paper, begun in No. 160, and continued in No. 162 of the same volume, is of great interest, and so much the more as the "Keythorpe system" spoken of in it, and executed on Lord Berners' estate, suggests, though only on a small scale, the establishment of absorbing bored wells. Thus, we read in the first paragraph, on p. 56, the following words of Mr. Joshua Trimmer:—"The distinguishing character of that system of draining was, that it took advantage of subterranean furrows between the soil and the subsoil," &c. &c.

Since, as we see from the last-quoted article, so many great things are still to be done for the improvement of wet land by drainage, which would indeed lay claim to the full activity of a competent judge in this department; and since large sums are set aside for obtaining these important purposes in a perfect manner, would it not be worth while, first, carefully to have the districts in question examined, in order to have pointed out those places where *absorbing bored wells* might be successfully established, and where not; and then immediately to make actual experiments in the construction of borings, as was done by me in Stetten, and thus probably to save to the country at least some part of the immense sums above quoted. Would it not be worth while to proceed in the same manner in different towns, boroughs, and villages, where, perhaps, a few perforations to a trifling depth, when treated skilfully, and with all possible caution, would carry off a large quantity of noxious fluids, and thus in a cheap manner replace an expensive system of sewers, &c., miles in length; or, where it might be advisable, to propose certain combinations of the common method of drainage with the establishment of absorbing bored wells.

My plain opinion is, that in all cases in which nature presents to us opportunity of adaptation to practical purposes, we should gratefully accept her kind offer, and carefully find out how far it can be made useful, before we can unconditionally resort to complicated and expensive technical systems; and that we should, according to the results of such investigation, employ the one or the other, or a combination of the two systems.

Finally, I remark, that, according to my manifold experience, a geological and hydrographical examination can generally be finished in a few days; it depends entirely on the result of the latter whether it will be advisable to propose an actual boring in order to obtain certain useful results, or whether such a project must be abandoned. The first and most important problem is always to find out when, and when not, the nature of the ground and the position of the place in question will enable us to carry out the desired intentions, and thus I believe that I can be of use in a twofold way:—

1. Under favourable circumstances, to advise and superintend the establishment of actual and successful works.

2. Under unfavourable circumstances, to dissuade from the construction of actual works, and thus to save sums which might be wasted for want of a careful survey beforehand.

These were the principles on which I operated in my practice on the Continent, during many years, and with satisfaction to my employers, as may be seen from the contents of my published works.

In conclusion, I may be permitted to quote a few lines from Alexander von Humboldt's "Comos," vol. I., p. 69:—

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* "Rudimentary Treatise on the Drainage of Towns and Buildings; suggestive of sanatory regulations conducive to the health of an increasing population." By G. Drysdale Dempsey, C.E., author of "The Practical Railway Engineer," and of the "Rudimentary Treatise on the Drainage of Districts and Lands." Second edition, revised and greatly extended.

† The geological maps, of which several have been published in England, give a good view of the formations of Great Britain. In the first note, on p. 611 of this journal, I have already pointed out the very good geological map of England and Wales arranged by Sir Roderick Impey Murchison. Others, and larger, are:—1. Geological Map of the British Isles and adjacent coast of France, constructed from published documents, communications of eminent geologists and personal investigation By John Phillips, F.R.S. and G.S., and engraved by J. W. Lowry; published under the direction of the Committee of General Literature and Education, appointed by the Society for Promoting Christian Knowledge. 2. Geological Map of the British Isles and part of France, showing also the inland navigation by means of rivers and canals, the railways and principal roads, and sites of the minerals. I. A. Knipe, London, second edition, 1856. (Mr. Knipe's smaller map has the title—Geological and Mineralogical Map of England and Wales, with parts of Scotland, Ireland, France, &c.) Besides, I may be permitted to refer unprofessional men to the useful book—"A Rudimentary Treatise on Geology, for the use of beginners. By Lieut.-Colonel Portlock, R.E., F.R.S., M.R.I.A., &c. Third edition. London: John Weale, 1854;" and to "Reynold's Popular Atlas of Geology, illustrating and describing the principles of the Science. Revised by J. Morris, F.G.S."

* Bell and Dally, 186, Fleet-street.

"Science only begins where mind takes possession of matter, where we strive to subject the multitude of ascertained facts to a knowledge based on reason; it is the intellect applied to nature."

ON MERCANTILE STEAM TRANSPORT ECONOMY.

A Paper read by Charles Atherton, Chief Engineer of Her Majesty's Dockyard, Woolwich, at a Meeting of the British Association, held at Cheltenham, in August, 1856.

The construction of ships and the administration of shipping affairs, involving a multiplicity of considerations of a scientific and of a practical and mercantile character connected with these arts, requires that shipping direction be regarded and treated as the subject of an exclusive science; and, of late years, the progressively extended application of steam to maritime purposes, and the prospect of its general use as an auxiliary power, have still further complicated the subject, and extended the range of mechanical acquirement which is now necessary in the prosecution of steam-ship equipment, direction, and management. It is, therefore, with diffidence, and with the feeling of my not possessing the combination of qualifications which is necessary to ensure adequate justice being done in all respects to the elucidation of the important subject, "Steam Transport Economy," that I enter upon the task of bringing that subject before the notice of the British Association for the Promotion of Science. I am, however, encouraged by the assuring reflection that public utility is a field in which it is an honour to labour, that lenient consideration for individual deficiencies and the helping hand of others will be extended to the most humble delvers in that field, and that credit may be earned in proportion to the roughness and obdurate nature of the spot of ground which we may have undertaken to break up, and to the perseverance by which one may at least attempt the accomplishment of the assigned task. Permit me, therefore, to remark that my present appeal to the British Association is but a continuation of my previous efforts in the cause of steam exposition, with a view to bringing "Steam Transport Economy" within the pale of arithmetical calculation; and as I shall have occasion to refer to the enunciation of principles and to the details of calculations which have thus preceded this essay, it may be convenient that I briefly enumerate the various published statements thus referred to as forming an integral portion of this paper, and which, accordingly, I beg to hand in to the Association for the purposes of reference and record.

1st. A brief essay on "Marine Engine Construction and Classification," published by Weale, in 1851.

The object of this essay was to analyse the data afforded by published and authentic statements of the actual test-trial performances of various steam-ships, and ascertain, by means of such comparative analysis, what are the peculiarities or proportions of build, and what are the peculiarities of engine-construction of those vessels which have attained to the highest degrees of locomotive efficiency, thereby also scrutinising how far the popularly received notions in regard to steam-ship type and marine engine construction, supposed to be most conducive to locomotive efficiency, may be in accordance with, or in opposition to, the results of actual experience, when measured by any definite and received law.

2nd. An essay on "Steam-ship Capability," originally published in 1853, and of which a second edition, with supplement, was published by Weale, in 1854.

This essay was designed to demonstrate the mutual relations which subsist between displacement, power, and speed in steam-ships; especially as respects the increasing scale of engine-power by which progressive increase of speed is attained; and to show the difficulties which attend the prosecution of a steam service in which long passages are required to be performed at a high rate of speed; also to show the sacrifice which attends the employment of vessels of an inferior type of build, as compared with vessels of a superior type. The supplement published with the second edition of this essay extended the tabular calculations to embrace vessels of hypothetical magnitude, and to demonstrate a system of £ s. d. arithmetical calculation applicable to estimating the cost of goods conveyance per ton weight by steam-ships, based on the constructive type of the ship, the speed to be realised, and the size of ship employed to do the work. The appendix to this essay embraces a dissertation on the probable capabilities of ships of unprecedented magnitude, showing the advantage of magnitude so far as mechanical principles are concerned irrespective of mercantile considerations, and under what combinations of speed and distance without re-coaling, comparatively with the more frequent coaling depots available to smaller vessels, the mechanical advantage of magnitude becomes neutralised; also giving new tables for facilitating steam-ship calculations, by showing the cubes of numbers from 5 to 25, rising by the decimal ·01, and the cube-roots of the squares of all numbers likely to be embraced in the tonnage displacement of ships.

3rd. A paper on "Steam Ship Capability," read before the Society of Arts, London, 16th May, 1855.

The object of this paper was to expose the indefinite nature of the terms "horse-power" and "tonnage" as respects their not being what they are generally supposed to be, definite units of measurement of engine-power and ships' size, also to show the uselessness for scientific purposes of all statistical data based on nominal horse-power and nominal tonnage, and the fallacy of all calculations based on those indefinite terms, thence showing the necessity for some definite measure of power being legalised as the unit of power to be denoted by the term "Marine Horse-power," and used as the base of calculation and contract engagement in steam shipping affairs.

4th. A paper on "Tonnage Registration" read before the Society of Arts, London, January 16, 1856, with the discussions thereon.

The object of this paper was to show the insufficiency for scientific purposes of the system of Tonnage Registration now in force as prescribed by the Merchant Shipping Bill of 1854, in so far that under this Act the registered tonnage of a ship affords no certain indication of the tons weight of cargo that the ship will carry, nor does it give, even approximately, the displacement with reference to any given draught, nor does the registration afford any indication of the power capable of being worked up to by the engines of steam ships, or any other data whereby the dynamic properties or locomotive duty of vessels may be scrutinised on scientific principles. In this paper, I brought forward certain suggestions for public consideration and discussion with a view to our official registration of shipping being rendered more comprehensive for the fulfilment of the various useful purposes to which statistical registration if complete would undoubtedly conduce, in a scientific point of view, irrespectively of merely fiscal objects.

These papers, of 16th May 1855, and 16th of January 1856, urging the establishment and recognition of definite units as the legal admeasurement of marine engine-power and ships' tonnage, I beg respectively to submit to the notice of the Committee appointed by this Association for the consideration of the tonnage question, of which Committee I had the honour of being named a Member, but I was under the necessity of declining to take part on this Committee in consequence of my being, as above stated, committed to certain views and publicly engaged in agitating the question of Tonnage Registration amendment, with a view to supplying the deficiencies of the present system.

Having thus shown that various investigations essentially connected with the elucidation of the subject now before us, "Steam Transport Economy," have constantly and pnblicly engaged my attention since 1851, I may now in the beginning of my paper announce the proposition to which I hope to direct the attention of the British Association.

Now, what I have undertaken to demonstrate is this: that, in consequence of there being no *legalised* definitions of the terms POWER and TONNAGE as standard units of quantity applied to the prosecution of steam navigation, there is practically no *definite* measure of quantity whatever attached to those terms, even although they are so generally made use of as the base of pecuniary contracts, and that, in addition to the private evils as between buyer and seller resulting from this singular anomaly in matters of mercantile account, the public evils, resulting from nominal "horse-power" and "tonnage" being terms which cannot be scientifically recognised as expressing either the working power of marine machinery or the size of a ship, are monstrous, inasmuch as they publicly defeat science from being brought to bear on steam ship construction and steam ship management as a means of investigation and proof whereby to confirm the existence and establish the continued adoption of good practice where good practice does exist, and to detect error either in the construction of steamers or in the management of steamers in cases where bad types of construction and maladministration may exist and be destructive of enterprise which might otherwise have conduced to public good. In short, my object is to show that in consequence of the deficienices in our national standard units of power and tonnage, and deficiencies of our statistical registration, the public are deprived of the benefits capable of being derived from science as a means of discriminating between good and bad practice in the great matter of shipping, thus enabling us to take advantage of the one and explode the other. The constructive merits of steam ships in a dynamic point of view may be comparatively determined by the ratio that subsists between the amount of displacement that is propelled from place to place, the speed or time in which the vessel performs the given passage, and the engine-power exerted or the coal consumed in the performance of the work; yet every ship that is launched and goes with flying colours upon the usual test-trial, is always for the day pronounced to be the most wonderful ship that ever was built, and no wonder that it is so, considering that the dynamic merits of ships are thus determined, not by any admitted rule based on the mutual relations of displacement, power, and speed, but by acclamation based on the mutual interests of all concerned, that a new ship shall be of good repute. All attempts to expose this monstrous deficiency in our nautical system by urging the importance of statistical registration, have been held up to reprobation as an interference with the shipping interests, regardless of the fact that it is the public who pay the penalty of an enhanced price of goods transport consequent on whatever deficiencies may exist in connection with the locomotive properties of our shipping.

In justification of these remarks as to our denominations of ships' tonnage and engine-power being a delusion, subversive of all truth so far as scientific inquiry and research may be based thereon, I may be permitted to adduce the following statements:—

1st. As to tonnage registration. Although tonnage measurement for registration has been subjected to legislative revision under the Merchant Shipping Act of 1854, the term "tonnage" is still made use of in various significations. By the present law, 100 cubic feet of internal roomage, or available space for cargo, constitutes the unit of tonnage, but as respects all ships built previously to the month of May, 1855, when this Act came into operation, the adoption of this law is not compulsory. Merchants have the privilege of retaining the former registration of some ships, and getting such others of their ships measured and registered under the new Act as they may think fit to select for re-registry, so that the term tonnage may now signify "builders' tonnage," old measure, under the Act of 1773, or tonnage under the Act of 1833, or tonnage under the Act of 1854, and these are three totally different systems of admeasurement, having no definite ratio to each other. Moreover, the unit of tonnage under the Act of 1854 being based on internal roomage *measuring up to the deck*, affords no certain indication of the displacement of a ship when loaded fit for sea, nor does it afford any assurance whatever as to the tons weight of cargo that a ship will carry, for example, by adopting the cellular principle of build now introduced in the construction of iron ships, a ship of 10,000 cubic feet of internal roomage, or 100 tons register tonnage, may have such external displacement as would safely float with the whole internal roomage filled with iron, and therefore weighing no less than 1,000 tons of dead weight, or ten times the register tonnage, and the registration of steam-ships is open to similar delusion as to their capability for weight of cargo. So much for the mercantile liberties that may possibly be introduced, and taken with our statistics of exports and imports so far as they may be based on the tonnage registration of shipping under the Act of 1854.

The abortiveness for statistical and scientific purposes which has hitherto attended all legislation on tonnage registration, appears to have been occasioned by the attempt to embrace under the one term, "Tonnage," two things which have no fixed ratio to each other, namely, tonnage by bulk, and tonnage by weight. The law has not comprehended the double mercantile use and application of the term "ton" by providing for the separate and distinct registration of each, namely, tonnage by bulk and tonnage by weight, the capability of ships for bulk tonnage being dependent on internal roomage, but the capability of ships for weight tonnage being dependent on external displacement, a distinction which is not noticed by the new law of tonnage admeasurement under the Act of 1854.

2nd. As to marine engine-power. Although Watt originally defined the unit of power, which he denominated horse-power, as equivalent to 33,000lbs. weight raised one foot high in one minute of time, and invented a mechanical device or instrument called a "steam indicator," whereby the variable pressure of the steam in the cylinder and consequently the working power of steam-engines could be readily ascertained (whence the working power so ascertained was denominated the "*indicated* horse-power"), all which arrangements of Watt put the working operation of the steam-engine originally on a scientific base, defined by a standard unit of power admeasurement, still this definite unit of power was never recognised by law, and consequently the steam-engine was no sooner applied to maritime purposes, than the rivalry of trade induced a practice under which the nominal, or contract power of engines, did not specifically regulate the working capability of the engine delivered. Engines were not objected to by the purchaser if their working capabilities were in excess of the nominal power, and engineers themselves voluntarily supplied marine engines working up to an "*indicated*" power far in excess of the "*nominal*" power, for the purpose of thereby driving the new vessel at a higher rate of speed than that attained by some rival vessel with the same nominal power. Reputation for the production of fast steamers depended on beating the rival boat, not on the mode of effecting that object. The shipping interests and their working craftsmen, shipwrights and engineers, felt themselves constrained to meet their rivals in trade with their rivals' weapons; numerous devices have been adopted with a view to the development of power on board ship by packing the greatest amount of engine-power into the least space, and undoubtedly great improvements have been made by adapting the dimensions and proportions of vessels to the service required, but still "Fame," in regard to the character of steam ships based on speed, has been too much the result of horse-power delusive jockeyship rather than of truthful science. By the practice of trade, horse-power came to be measured by the diameter of the cylinder, without any limitation as to the capabilities of the boiler, and gradually in time a marine-engine contract was considered not to be fulfilled unless the engines were capable of working up to an "indicated horse-power" at least double that of the contract nominal power; still, however, no specific limit was assigned either by custom or by law, and, at length, to such a degree has competition set truth at defiance, that the working, or "indicated horse-power" of engines delivered under contract has frequently amounted to four times the nominal horse-power actually stipulated for by the contract. These facts are fully set forth in the paper read by me before the Society of Arts on the 16th May, 1855.

Having thus pointed out the indefinite application in steam shipping practice of the terms "tonnage" and "horse-power" with reference to the definite terms "displacement" and "indicated horse-power," it may be still further edifying that we illustrate the anomalies liable to result when these terms are used in combination with each other, as is constantly the case in expressing and recording the ratio of tonnage to power of a steam-ship. In exposition of this matter, I may again refer to the before-mentioned paper, whereby it will be seen that I selected ten vessels, in each of which the ratio of builders' tonnage to nominal power was very nearly the same, namely, in the ratio of 100 tons of builders' tonnage to 40 nominal horse-power, or 2½ tons of tonnage to one nominal horse-power; but on comparing the constructors' load displacement of these same ships, calculated in tons weight at 35 cubic feet of water to the ton, with the *effective* working power, based on indicator measurement, the ratio was found to be 100 tons displacement to 38 horse-power in one case, and 100 tons displacement to 281 horse-power in another.

The recorded statistics of these ten vessels would lead one to infer that they are all powered in the same proportion of engine-power to size of ship; but, in fact, they are all different, and on comparing the two extremes, one ship has no less than seven times the power of the other, in proportion to size of ship as determined by displacement. In fact, generally, the records of register-tonnage and nominal horse-power do not constitute statistical data of any value whatever for the scientific purpose of discriminating between the relative dynamic merits of steam-ships, but, on the contrary, such records and all ideas resulting therefrom are positively delusive and mischievous. The conclusion at which I would arrive from these statements is, that the very first step in any attempts to bring steam affairs within the range of arithmetical calculation must necessarily be to establish the measure or value which we assign to our units of tonnage and power. It is only by the moral influence of such a body as the British Association that the cause of science can obtain a hearing in this matter of statistical registration applied to shipping. With reference to our units, it is, of course, desirable that the measure of the unit, to be legally recognised as the unit of power, should be nearly in accordance with the general average of practice at the time when the unit may be so established; and as at the present time (1856) the general run of marine nominal horse-power varies from two indicated horse-power to four indicated horse-power, that is, from 66,000 lbs. to 132,000 lbs. raised one foot high per minute, it is submitted that the unit of marine horse-power would now be most conveniently fixed at 100,000 lbs raised one foot high per minute. Until, however, some definite measure of the unit be legally recognised it is considered advisable in matters of scientific inquiry like the present to adhere to the measure of the unit originally proposed by Watt, namely, 33,000 lbs. raised one foot high per minute, designating this scale of measurement as the "indicated horse-power," thus:—Ind. h. p.; and such will be the unit referred to when horse-power is spoken of in the following pages of this paper.

Now, as to the measure of the unit of tonnage by which the sizes of ships are to be spoken of and compared, we have already observed that under the Merchant Shipping Act passed in the year 1854, the unit of tonnage is based on the internal roomage of ships available for cargo; that all ships built since May, 1855, are registered under this Act; but the re-measurement and re-registration of ships built previously to 1855 is not made compulsory. Shipowners have the privilege of re-registering, under the Act of 1854, such vessels as they may select for that purpose; consequently, our present registration is mixed, and the various units of tonnage-measurement thus embraced under our present tonnage-registration have no definite ratio to each other, or to the tons weight of cargo that ships will carry. The comparative merits or demerits of these various systems of registration for *fiscal* purposes need not be here discussed. Suffice it to say that in none of these systems has any notice whatever been taken of the measurements which constitute displacement; and as displacement is an essential element in any scientific investigation as to the locomotive performance of steam-ships with reference to the power employed and speed attained, it follows that our present registration of shipping, even under the Act of 1854, does not afford statistical data of such a character as to be available for science in the matter of comparing the merits, in a locomotive or dynamic point of view, of the various models or types of form by which steam-ships have been constructed. It is submitted for the consideration of the British Association that national advancement in maritime affairs, especially in regard to transport economy, would be promoted by our public registration of shipping in general, and of steam shipping in particular, being so systematized as to embrace not only the roomage measurement required for fiscal purposes, but also, in addition, those details of *displacement* which in combination with the data of speed and power derived from the actual performances of ships, are necessary to scientific investigation in determining the relative dynamic merits of different types of form of steam-ships. It must be borne in mind that it is the Public, the consumers of merchandise, who must ultimately bear all the expenses connected with the transport and delivery of merchandise, whether well or ill performed. Bad ships individually enhance the average cost of imported corn and all other consumable merchandise. Bad ships also enhance the price of cotton and all other similar raw material imported for the production of export manufactures. This enhanced price restricts demand, thus curtailing the sources of employment, so that every bad ship, whether employed in the import or export trade is, of itself, a public nuisance, a prevalent bad type of ships would be a public calamity, and progressive improvement would be a public benefit. It has been said that the interests of shipowners is in itself a sufficient guarantee for insuring the adoption of the type of ships best adapted for mercantile steam-transport economy. It is scarcely fair to base any argument on interested motives, but as that argument has been raised it must be noticed. Undoubtedly, each shipowner has an individual interest in his own ships being the best afloat, but if he does possess the best ships, it is equally his interest to keep that fact and the means of acquiring them to himself, so that the charges for freight may continue to be ruled by the inferior dynamic qualities of the average ships employed by the trade, not by the superior dynamic qualities of the best ships as possessed by himself, the difference being the shipowner's private advantage or the public's loss. It is, therefore, the interest of the public that all bad types of shipping be exposed and eradicated. Freight would then, as respects the quality of ships, be ruled by a scale of charges derived from the performance of a generally improved type of ships working in fair competition with each other.

(*To be continued.*)

ART TREASURES EXHIBITION.

A proposition has been made to the Executive Committee of this Exhibition, by Messrs. Fenton and Delamotte, to take a series of photographs of the most remarkable objects which will there be collected, so as to form a permanent memorial of the event. The series would naturally comprise photographs of the building itself, both in progress and in a complete state, and of selected specimens from the pictures, both ancient and modern, of the sculpture in wood, marble, ivory, bronze, terra cotta, &c., and of the decorative furniture, tapestry, goldsmiths' work, glass, and pottery. Such a series would not only form a permanent memorial of the Exhibition, but, by the facility with which copies can be multiplied, would tend greatly to increase the general knowledge of art, and elevate the national standard of taste. A complete collection might be formed as a permanent Art Exhibition for the Museum in Manchester, thus affording a source of continual instruction to the working men of that place. If such an undertaking be determined upon, no time should be lost in commencing the work, and no doubt the owners of works of art would readily grant facilities for its execution.

ANTHRACITE DOMESTIC FIRES.

An American correspondent, now a resident in England, in reply to a letter from the Secretary, writes as follows:—

"With regard to the open principle of burning anthracite, to which you allude in the latter part of your letter, I am happy to say that I am quite familiar with it, as I never used any other than anthracite coal in America. There are peculiarities about it, both in the construction of the grates, and in the mode of making the fire. The bars of the grates must be made upright. and their cross-section should be an isoceles triangle, with the open side next the fire. The bars should be about an inch and a quarter apart, and should be uninterrupted by cross-bars in their whole length. Instead of a large open space above the fire, as used here, the jambs should be no further apart than the width of the grate, and the throat of the chimney should be narrow. You will see that all these provisions have for their object to obtain a fierce draught, without which anthracite cannot be successfully burnt. Added to all, is a *blower*, which covers the whole of the fire-place down to the bottom line of the grate. This is only used when the fire is kindled, and when fresh fuel is applied, which latter operation need only be performed once or twice in the course of the day. The kindling is an operation in which a novice would be very apt to fail. In America, charcoal is generally used for the purpose, because it is so cheap, and burns so freely; but wood or bituminous coal would answer. The anthracite should be added gradually, until a considerable quantity of it has become ignited. When it once begins to burn, the whole difficulty is over, and it is quite common with us to keep a fire in all the winter, night and day. The fire once made, burns brightly five or six hours without attention, and gives a great heat. If the air be found too dry, an open pan of water will remedy the evil. To renew the fire, fresh coal is put on, the ash is removed by the poker, and the blower applied for a minute or two.

"You ask whether the system answers? I can only say that it is universal in America, and that we keep very comfortable through long winters, with the thermometer constantly in the neighbourhood of zero, almost as often below as above it. As a mere matter of taste, I prefer bituminous coal, on account of the cheerful blaze, but it is much more troublesome, and very destructive to all beautiful objects that may be in the room where it is burning. Anthracite, on the contrary, gives no smoke, no blacks, only a fine dry dust, that is easily removed. Hence, it does no injury to fine furniture or works of art, and gives the housewife some encouragement to neatness and elegance in every part of her establishment, as it is not condemned, as here, to eternal, inevitable dinginess.

"I am not aware that there is an anthracite fire-place to be seen here. It would cost very little to try the experiment, and I should be happy to aid in it to the best of my ability. If the Society felt disposed to have such a grate put up, I will furnish the necessary drawings and instructions, and superintend the trial, if you desire it.

"With regard to the pecuniary question, anthracite is the most economical fuel by far, when the two descriptions of coal are at the same price per ton. That is usually the case with us, but the bituminous coal is comparatively little used for domestic purposes."

NEW PROCESS OF STEREOTYPING.

A new and simple method of stereotyping has just been patented by Mr. Hogg, of Edinburgh. The process consists of a mixture of various ingredients, finely pulverised, and mixed up to the consistency of putty. In this state the substance is spread with a knife on a piece of wrapping paper, and then passed under an accurately adjusted straight-edge, by which means a surface as smooth and equal as a sheet of paper is obtained. The material for the matrix being thus formed, it is laid on the types, the composition, in a soft state, being next the face. An impression is then taken by the common printing press, but the pressure required is so slight, that Mr. Hogg uses an ordinary copying press for the purpose. The matrix, affixed to the face of the types, is then laid on a gently heated hot-plate for about twenty minutes, after which it is ready for being cast from. From the impression being taken as in the ordinary mode of printing, a perfectly level surface on the face of the stereotype plate is attained. There is no shrinking or twisting of the matrix, as in casting from stucco. No more damage is done to the types than by pulling a proof at the hand-press; what printers will understand as low spaces and leads are preferred; there is no filling up of the types with the material of which the matrix is made. Little of what is understood as "picking" of the plates is required, while the saving to the printer in the wear of types is very great. This process admits of the metal being used at any temperature.

Home Correspondence.

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A NEW MANURE.

Sir,—The new manure, the experiments on which are detailed below, is a waste product, which arises in the purification of gas by my process patented two years ago. In this process, common clay is used as an auxiliary to lime in the purification of gas. The clay absorbs and retains, in the form of true chemical compounds, substances over which lime has no power; which are most detrimental in gas, but of great practical value as manure. The clay, when spent as a purifying agent, contains ready-formed ammonia in considerable quantity, part of which exists in volatile, but the larger part in non-volatile, salts.

It contains also much nitrogen, variously combined with other substances, which, by eventual decomposition in the soil, will form carbonate and sulphate of ammonia. This portion of nitrogen becomes active only after some time, and, therefore, the crops thus manured are *sustained* in their later periods of growth as well as *stimulated* in their infancy.

It also contains a quantity of sulphur, carbon, and phosphorus, in forms of combination which experience has shown are valuable as plant-food, but the description of which would involve too much technical chemistry to render it suitable in a popular account intended for general perusal.

The clay employed for purification is such as is commonly used for brickmaking. This is pulverised and slightly moistened before being placed in ordinary dry-lime purifiers. When saturated it is removed thence, a black fœtid mass, loaded with impurity.

Exposure to the atmosphere oxidizes some of the absorbed substances, and the clay may be used a second time with advantage, when the object is to *manufacture manure* as well as purify gas. The saturated clay needs nothing but laying a short time under a shed to dry, before it is made fine, like guano, and applied to the land.

Present experience shows that a ton per acre is an adequate, and a ton and a half per acre a maximum, dressing for grass land; a ton per acre is the maximum quantity for arable land, and when so much as this is put on, it should be ploughed down and not suffered to come into contact with the seed. Half-a-ton mixed with the manure has operated most beneficially upon potatoes, and will probably do so upon turnips. It has not been thus tried, but used alone broadcast it has grown capital turnips.

The *cost* of producing this manure is comparatively trifling, and when sold at 5s. per ton it leaves a handsome profit to the company producing it.

The *quantity* capable of being made is enormous, and daily increasing. One single London Gas Company is probably able to produce upwards of 40,000 tons per annum. The gas companies in the United Kingdom number, I believe, about a thousand, and obviously could supply almost any demand.

Elijah Smith, gardener to the Wakefield Union Workhouse, tried a load of the new manure from the Wakefield Gas Works in 1854. He applied it alone to:—1, early turnips; 2, onions; 3, broccoli; 4, cabbage.

1. The turnips were particularly fine, having tops upwards of two feet six inches high, with leaves broader than a man's hand.

2. Onions killed by excess of manure.

3. Broccoli became, a short time after planting, as blue as if painted, but still the plants grew freely. Gradually the blue changed to a dark luxuriant green, and the quarter was the admiration of all who saw it. The severe winter of 1854-5 killed much of this broccoli, as it did all in the neighbourhood. What was alive was considerably hurt, but as spring advanced it became luxuriant, and produced as fine heads as could have been obtained by any manuring whatever.

4. Cabbage, planted very late and bad plants. Looked badly all the winter of 1854-5, but when the growing season commenced in spring it looked quite as well as a neighbouring quarter well manured with stable dung, and hearted as well, though about three weeks later.

Soil a hungry sandy loam upon poor sandstone gravel.

John Turner, farmer, Stanley, used a single part of a load (from Wakefield Gas Works) upon grass applied early in January, 1855. Patches of grass were killed where the manure was put on too thickly, but all around the dead spot the grass grew in the most beautiful manner. On the 1st of May, 1855, the grass on the manured spots was 6½ inches high, while, owing to the dry weather, the rest of the field was bare. The enormous difference of colour and crop was visible to every one. Patches of the finest green Genoa velvet upon an old brown frieze coat, is no inapt picture of the difference. At mowing time there was more than three times the quantity of grass where this manure was put than there was in other parts of the field.

Encouraged by this result he dressed the whole of a 9½ acre field, in 1856, save three lands in the middle, which were manured with "short muck." Remarked all through the spring the beautifully dark green colour of the dressed portion, and that where most of the manure was put the grass looked best. The field is now open to inspection, and in the third week in June, where the new manure was properly put on the grass measured on an average maximum 42½ inches, minimum 27 inches. The part not dressed with this manure was maximum 24½ inches, minimum 14 inches. Soil here a strong cold undrained clay, in many parts wet.*

John Thompson, farmer and assistant-overseer, Outwood, near Wakefield, obtained two small loads from the Wakefield Gas Works, and mixed it with about an equal amount of soil. This was applied to about two acres of grass. Against it were used:—1, farm-yard manure mixed with soil; 2, lime and soil compost. In this instance the colour has been throughout better with the new manure. It continues to have the same marked difference in colour; it is thicker in the bottom, and very much stronger than either of the other plots against which it was tested. I visited this field in company with a friend, and we were both struck with the great superiority of the grass grown with the new tillage.†

I have made several experiments with it myself. In October, 1854, I applied about a ton to half an acre of land, for cabbage. The severe winter killed a considerable portion of the crop. Windsor beans were, therefore, planted among part of the cabbage in the spring of 1855. These produced largely, and the cabbage which was not killed did well. Another part of the cabbage-crop was destroyed, and the ground planted with long red mangold wurzel in April, 1855. The extremely dry season rendered root crops in the neighbourhood very deficient, but notwithstanding the drought, this mangold looked well and grew freely, and when topped and tailed, and weighed at the public weighing machine, was found 24 tons 4 cwt. per acre.

A crop of white wheat is now growing upon this half-acre, and could not look better. The leaf is broad and almost black green. The straw is particularly strong, and all who have seen it pronounce it the best wheat they have seen this year.

Besides this, an acre of the same kind of white wheat is growing in the same field. This was sown after potatoes, manured with part of the heap mentioned in my essay on the Fermentation of Manure, in the *Journal of the Royal Agricultural Society*, pp. 11-12, experiment 5, and in note p. 12, experiment 2. This crop is very fine, but the former is decidedly superior in three respects. 1. The increased darkness of colour, owing to the more highly-nitrogenised manure. 2. The broader leaf. 3. Stronger straw, due to the soluble silicates in the manure when applied, and also, I think to the silica rendered, soluble by the ammonia produced (in the presence of silicates) from the nitrogen which exists in the clay. principally in combination with carbon and sulphur Perhaps I ought to add, 4thly, the rather shorter straw, which renders the crop less liable to lodge. The potato wheat averages 40½ inches in height; and that grown with the new manure, 37½. Seed, two bushels per acre, sown broadcast and ploughed down. Since sowing-time, *nothing whatever* has been done to either crop, that no disturbing element from culture might vitiate the comparison.

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* The hay from this field is stacked, and fully realises the promise it gave before being mown. An examination of the field since it was mown shows that the crop might have been improved by more careful spreading of the manure, as in some places too much has been put on, and in others too little. The after grass grows very rapidly, and the field will pay well for mowing again, if the weather be fine to get the second crop. This is certainly striking, as the field had not been manured for four or five years, and yet had been mown annually, and the cost of manure per acre this year was less than 7s. 6d.

† This crop is mown and carried, and Mr. Thompson informs me that the grass on the portion manured with the new manure was double that upon either of the other portions. Here the cost was 5s. per acre with this fertiliser, while the farmyard dung cost 30s., and the lime compost not very much less.

A very instructive though unintentional experiment was made in this field. The load of manure from the gas-works was shot up and allowed to remain in a heap for a few days, owing to wet. When spread, it was carefully shovelled up, and nothing was supposed to be left. On this area nearly every plant of wheat died as soon as it sprung up; and the few plants which were not killed are so dwarfed and injured by the excess of manurial substance, that it is doubtful whether they will ever bear anything. *But around the margin* of the heap, where a relative excess of manure was scattered, but where there was no drainage from it, the crop is extremely luxuriant. Oct., 1854.—This manure was applied at the rate of more than 5 tons per acre to a piece of land containing about 300 square yards. Every crop sown or planted on this land was killed, or so stunted as to be worthless, till some cabbages were planted in 1855, which have stood the winter, and are extremely dark in colour, but smaller than others of the same kind growing on adjacent land manured in the ordinary manner. Potatoes, interlined between cabbage, grow freely, and are very dark in colour. The known excess purposely applied in this case is only just beginning to expend itself sufficiently to do good instead of harm.

A ton of the manure was mixed with a manure heap, and applied to three acres of potatoes planted this spring. Planting began April 22nd, and finished May 5th. Part of the sets were sprouted, and set with the spade. The rest were set by the plough in the usual manner. All grow fast, and look well. Unless dry weather comes soon, those which were sprouted will produce too much top.*

In the spring of 1855, a plot of bad grass, which I know had not been manured for ten years, was freely dressed with this manure. The dressing was as large as can be safely given. This plot was mowed *five times* by a man in the neighbourhood, to whom the grass was given for his horse. Each time the swathe was close and heavy; while, on an unmanured portion adjoining, the grass would hardly stand against the scythe. At one mowing, when about a foot high, the grass was beginning to rot at the bottom, owing to its thickness. This is a particularly favourable result, when the extreme dryness of 1855 is remembered.

I am, &c.,

W. R. BOWDITCH.

P.S. I am informed that Mr. Pepper used it with the best results, but I did not see his grass.

NEGATIVE OR ABSORBENT ARTESIAN WELLS.

SIR,—In reference to the description of absorbent artesian wells in this country, or negative artesian wells, as Dr. Bruckmann proposes to new name them, I beg to call his attention to an article by me in the *Civil Engineer and Architects' Journal*, Vol. III., p. 118, for April, 1840, in which the system, as adopted in France, is fully described, with suggestions for its application in Hackney, Lambeth, and Woolwich.

I am, &c.,

HYDE CLARKE.

42, Basinghall-street,
9th August, 1856.

Proceedings of Institutions.

HALIFAX.—The new building of the Mechanics' Institute is now nearly completed. It contains a large assembly room, able to accommodate 700 persons; in addition to which there is a library and reading-room, and twelve class rooms, besides a large one, intended for a class in drawing and design. The estimated cost of the building is stated to be £8,000, towards which about £3,400 have been already subscribed. The number of members is at present about 500, and in the classes, which are fourteen in number, about 200 male and 60 female pupils are instructed. The hall will probably be opened at the latter end of October.

To Correspondents.

ERRATA.—In the last number of the *Journal*, p. 633, col. 2, note, line 1, for " Brunnenstaben," read " Brunnenstuben ;" line 4, for " Meber Arlegung," read " Ueber Anlegung ;" line 6, for " Breisganes," read " Breisgaues ;" line 7, for " Fromberg," read " Fromherz ;" p. 634, col. 1, line 17, for " Brunnenstaben," read " Brunnenstuben ;" notes, line 3, for " Auerstedt," read " Qnenstedt ;" line 21, for " Zahrbücher," read " Jahrbücher ;" p. 636, col. 1, notes, line 7, for " Auellen," read " Quellen ;" line 9, for " Perisdicität," read " Periodicität ;" and for " Auellen," read " Quellen ;" col. 2, line 2, for " Buschelesteich," read " Büschelesteich ; p. 637, col. 1, note, line 2, before " Fertigung," insert " zur ;" p. 638, col. 1, note, line 19, for " obserwäbischen, read " oberschwäbischen."

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette August 8th*, 1856.]

Dated 16th July, 1856.

1669. John Bourne, 9, Billiter-street, City—An improved construction of paddle wheels, usually termed "feathering paddle wheels." (A communication.)

Dated 17th July, 1856.

1683. John Cartwright, Shrewsbury—Improvements in agricultural implements called "chain harrows," for more effectually dressing and cleaning land.

Dated 21st July, 1856.

1715. Elias Leak, Longton, Staffordshire—A thimble pillar, with points and branches, to be used in placing "glost" china and earthenware in ovens and kilns, when firing, burning, or baking such ware, in lieu of the cockspurs and stilts now in use for that purpose.
1717. Francis Barbour, Manchester—Improvements in pen-holders. (A communication.)
1719. James Clark, Newton Heath, Manchester—Improvements in the manufacture of waterproof fabrics.
1721. John Gedge, 4, Wellington-street South, Strand—Improvements in obtaining and applying motive power. (A communication.)
1723. Maurice Vergnes, New York, U.S.—Improvements in electro-galvanic machines for producing motion by galvanic electricity.
1725. John Edward Hodges, Leicester—Improvements in machinery for the manufacture of looped fabrics.
1727. Jacob Bing, Hamburgh—A new sauce boat, or vessel for containing liquids of different densities.

Dated 22nd July, 1856.

1729. Clothide Amet, Tavistock-street—Improved means of distending articles of dress and preserving the form or shape thereof. (A communication.)
1731. Elias Weisskopf, Pesth, Hungary—An artificial combustible, chiefly applicable to the kindling of fires.
1733. Sven Johan Agrell Burg, 1, Serle-street, Lincoln's-inn—Certain improved apparatus for preventing the explosion of steam boilers. (A communication.)
1735. Samuel Butcher, Bristol—Improvements in kitchen ranges.
1737. James Clark, Newton Heath, Manchester—Improvements in the manufacture of beds, mattresses, cushions, and seats.

Dated 23rd July, 1856.

1739. George North, 9, Ashburnham-road, Greenwich—An improved spring catch for the security of jewellery and articles of personal ornament and general utility.
1741. Ferdinand Potts, Birmingham—Certain improvements in tags for stay and other laces, as also in the machinery for forming and finishing the same.
1743. William Webster, 22, Bunhill-row—An improved steam and fire regulator. (A communication.)

*** These potatoes are by general consent admitted to be the best in the neighbourhood. The tubers answer to the luxuriance of the tops, and, if not injured by weather, they cannot fail to be a heavy crop.**

1744. William Webster, 22, Bunhill-row—Improvements in pumps. (A communication.)

1745. Roger Bolam Ellison, 9, Brook-street, London-road, Carlisle—Improvements in electric telegraph apparatus.

1747. Alexander Bain, Brompton, and Bennett Johns Heywood, Leicester-square—Improved apparatus for supplying and drawing off liquids, and for stopping the flow of liquids and æriform bodies.

1749. John Derbyshire, Longton Potteries, Staffordshire—Improvements in cocks, taps, and valves.

1751. Constantin Louis Detouche and Jean Jacques Emile Robert Houdin, junr., Paris—Improvements in the application of clocks or timekeepers, actuated by electricity, to street and other lamps.

Dated 24th July, 1856.

1753. Helmuth Carl Friedrich Martin Petschler, Manchester—Improvements in obtaining and applying motive power, and in the machinery or apparatus connected therewith.

1754. James Ashman, Swansea—Improvements in the manufacture of artificial limbs.

1755. Charles Burton, 162, Regent-street—Improvements in warming houses and other buildings.

1756. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—An improvement in the manufacture of driving straps or bands. (A communication.)

1757. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in the manufacture of flexible hose and tubes. (A communication.)

1758. George Collier and John Crossley, Halifax, and James William Crossley, Brighouse, Yorkshire—Improvements in finishing and stretching woven fabrics.

1759. George Alexander Copeland, Constantine, near Falmouth, Cornwall—An improved safety blasting cartridge, for the use of miners and quarrymen.

1760. Charles Tiot Judkins, 98, Fleet-street—An improved gas regulator.

1761. Joshua Mather and William Forshaw, Bolton-le-Moors—Certain improvements in pickers for looms and apparatus connected therewith.

1762. Richard Archibald Brooman, 166, Fleet-street—Improvements in grindstones. (A communication.)

1763. Charles François Cattaert, Paris—Improvements in the stoppering of inkstands, bottles, pots, jars, and other vessels, and closing cocks.

Dated 25th July, 1856.

1764. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in the manufacture of vulcanized india-rubber thread. (A communication.)

1766. Edward Lord, Thomas Lord, Abraham Lord, and William Lord, Todmorden—Improvements in machinery for opening, blowing, scutching, and preparing cotton and other fibrous substances.

1767. William Wood, Monkhill-house, Pontefract—Improvements in machinery or apparatus for weaving pile fabrics.

1768. Thomas Byford, Carlton-villas, 34, Edgware-road—Improvements in horses' bits.

1769. Robert Stewart, Glasgow—Improvements in cutting stone and other mineral substances.

1770. Thomas Wrigley, Bury—Certain improvements in machinery or apparatus for cleaning "cotton waste" or other materials used in the manufacture of paper.

1771. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in scutching machines. (A communication.)

1772. Samuel Jay and George Smith, 246, Regent-street—Improvements in stuffing or padding couches, cushions, bedding, chairs, and other similar articles.

1773. Ebenezer Howes, Liverpool—An improved construction of anchor. (A communication.)

1774. William Lanphier Anderson, Norwood, Surrey—Improvements in propellers.

1775. Isham Baggs, Manchester-street, Argyle-square—Improvements in apparatus for lighting, signalling, and telegraphing by means of electricity.

1776. Julien Denis, Queenhithe—Improvements in cutting or perforating steel and other metals. (A communication.)

Dated 26th July, 1856.

1777. Joseph Platt, Audlem—Improvements in door-knockers.

1778. Charles Hodges, Manchester—Improvements in apparatus for unwinding silk, thread, or yarn from the hank. (A communication.)

1779. Richard Clarke Pauling, Great George-street, Westminster—Improvements in giving increased buoyancy to ships and vessels, in raising sunken vessels, in keeping structures water-tight, and in propelling vessels.

1780. James Dickinson, Liverpool—Improvements in anchors, and in the manufacture of the same.

1781. Samuel Yeadon, Idle, near Bradford, and George Chapman, Stockport—Improvements in the construction of reeds for weaving, and in machinery or implements and materials to be used in such construction.

1782. George Colleton Cooke, George-yard, Lombard-street—Improvements in stereoscopes.

1783. Henry Remington, Camberwell—An improved gas heating and cooking apparatus.

Dated 28th July, 1856.

1787. Edmund Eaborn and Matthew Robinson, Clement-street, Birmingham—Certain improvements in machinery to be used for confectionery purposes.

1789. William Edward Newton, 66, Chancery-lane—Certain improvements in steam-engine governors. (A communication.)

Dated 29th July, 1856.

1791. William Griffin and Elizabeth Duley, Northampton—Improvements in studs and buttons for fastening articles of dress.

1793. John Knowles, Derby, and William Buxton, Brimington—Improvements in tuyères.

1795. Henry Richard Bowers, Penbedw, near Ruabon, Denbighshire—Improvements in machinery or apparatus for grinding, crushing, or pulverizing clay and other substances.

1797. Alexander Williams Anderson, Trinidad—Improvements in refining sugar.

WEEKLY LIST OF PATENTS SEALED.

Sealed August 8th, 1856.

343. John Elce and Samuel Fletcher Cottam.
356. Henry Bessemer.
361. Frederick Steiner.
365. William Frederick Collard Moutrie.
366. Samuel Fox.
367. Richard Knight.
372. Henry Fort Mitchell and Wm. Mitchell, and John Clarkson.
383. John Taylor.
389. George Gulliver and John Goldthorpe.
439. William Oliver Johnston and John Dixon.
457. Leonard Bower.
472. Samuel Rodgers Samuels.
485. John Barrow.
515. Pierre Louis Grosrenaud.
530. John Henry Johnson.
541. Julius Homan.
679. John Henry Johnson.
700. William Edward Newton.
1097. George Jordan Firmin.
1099. William Edward Wiley.
1113. Bartholomew Beniowski.
1116. Richard Whytock.
1122. Michael Hodge Simpson.
1124. Hiram Tucker.
1129. William Edward Newton.
1224. Charles Barreswil.
1243. Pierse Eustace Laurence Barron.
1254. William Hulse.
1257. Frederick Charles Jeune.
1279. Alexander Drew and Matthew Gray.
1339. John Norris, jun.
1390. James Eives.
1417. Charles Desnos.
1428. James Eives.
1437. Matthew Andrew Muir and James McIlwham.
1450. William Radley.

Sealed August 12th, 1856.

362. Pierre Isidor David.
363. John Mills.
391. Edward Oldfield.
394. James Hogg, junr.
397. John Henry Johnson.
402. George Harrison.
455. William Vincent Wallace and Benjamin Lawrence Sowell.
467. Robert Baker Jones,
491. John Cornes.
493. Francis Thompson.
557. Samuel Last.
569. Richard Archibald Brooman.
579. Robert Hannah.
819. George Tomlinson Bousfield.
1087. Alexander Charles Louis Devaux.
1099. William Basford.
1267. William Edward Newton.
1275. George Bell and George Charles Grimes.
1387. James Combe.
1427. Arthur George Baylis.
1483. John Henry Johnson.

EXTENSION.

Sealed August 8th, 1856.

13. John Lee, Brunswick-street, Trinity-square, Southwark—Certain improvements in wheels and axle-trees to be used in railways, and in machinery for stopping on or preventing such carriages from running off railways, which improvements might also be applied to other carriages and machinery.

Patents on which the Third Year's Stamp Duty has been Paid.

August 5th.

1838. John Hughes.
1839. John Marten.

August 6th.

1855. William Baines.
1863. Samuel Hall.
1876. William Longmaid.
1889. Thomas Allan.

August 7th.

1862. Thomas Mac Sweny.

August 8th.

1874. George Deards.
1911. Richard Archibald Brooman.

August 9th.

1870. Richard Farmer Brand.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3865	July 31.	United Service Square	Charles William Lancaster ...	New Bond-street.
3866	Aug. 2.	The Compound Spade Plough	William Chamberlain....... ...	Dodbrook.
3867	Aug. 4.	Hobble for Cattle	William Middlemore............	Birmingham.